

## DESCRIPTION

RADIO BASE STATION APPARATUS, COMMUNICATION TERMINAL  
APPARATUS AND METHOD OF TRANSMITTING CONTROL INFORMATION

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## Technical Field

The present invention relates to a technology for  
transmitting control information necessary for a  
communication terminal to form an uplink transmission  
10 packet from a radio base station to the communication  
terminal.

## Background Art

Conventionally, various improvements have been made  
15 about a scheme for enabling high-speed packet  
transmission on a downlink from a radio base station to  
a communication terminal (e.g., HSDPA (High Speed  
Downlink Packet Access)). This entails an expansion  
which enables large-volume or low delay data transmission  
20 on an uplink channel from the communication terminal to  
the radio base station, too, and studies on a scheme for  
realizing high-speed packet communication on an uplink  
channel (e.g., Enhanced Uplink DCH) are underway.

As with the downlink, studies on the introduction  
25 of a scheduling technology for an expansion of such  
high-speed packet communication to an uplink channel are  
also underway. The base station carries out scheduling  
on uplink packets and the base station sends scheduling

information created to each communication terminal.  
Each communication terminal transmits uplink packets to  
the base station based on the scheduling information  
received from the base station.

5           As the scheduling method by the base station, there  
are proposals on a method called "Base-station Controlled  
Scheduled Transmission" and a method called "Base-station  
Controlled Rate Scheduling."

          Of these methods, the method called "Base-station  
10   Controlled Scheduled Transmission" is similar to  
scheduling when high-speed packet transmission is  
performed on a downlink such as HSDPA. That is, the base  
station selects several communication terminals for  
transmitting uplink channel packets and instructs only  
15   the selected communication terminals on a (maximum)  
transmission rate or transmit power margin, etc.

          A method of transmitting control information such  
as scheduling information from the base station to each  
communication terminal (hereinafter this may be referred  
20   to as "downlink control information") in this case is  
described in "3GPP, R1-030067, "Reducing control channel  
overhead for Enhanced Uplink" (hereinafter this will be  
referred to as "Document 1"). This method is for  
transmitting downlink control information for each  
25   communication terminal selected by scheduling using a  
downlink channel called "Downlink Scheduling Assignment  
Control Channel." That control information consists of  
transmission timing information, transmit power margin

information, identification number for identifying the destination communication terminal (included in a CRC) and a Tail bit for coding.

The method called "Base-station Controlled Rate Scheduling" also causes the base station to assume the responsibility for rate control in uplink channel packet transmission which used to be carried out at a relatively low speed by an RNC (Radio Network Controller) so as to perform rate control at a high speed. This rate control can be realized with additions of a relatively small number of functions for a communication terminal and an improvement of throughput is also expected on the other hand, and therefore this can be considered as an effective method.

This rate control method is explained in "3GPP, R1-03-0129, Two Threshold NodeB Packet Scheduling" (hereinafter referred to as "Document 2"). More specifically, by sending control information instructing an increase/decrease of a transmission rate made up of Up/Down/Keep called "RG (Rate Grant) information" to all communication terminals carrying out uplink packet transmission, the base station controls a maximum transmission rate of each communication terminal individually. Since a Keep command can be expressed by "not transmitting RG information (no transmission)", it is possible to actually send Up/Down. The communication terminal transmits uplink packets at a maximum transmission rate or below in consideration of a transmit

power margin and amount of data. However, transmitting these two values of Up/Down is only an example and it is also possible to instruct an increase/decrease of the transmission rate in further detail if downlink control information can transmit a plurality of bits.

The aforementioned Document 2 describes that it is also possible to apply a technology of hybrid ARQ, etc., at the same time. That is, downlink control information to be transmitted from a base station to a communication terminal can be ACK/NACK of hybrid ARQ, etc., in addition to RG information.

In uplink packet transmission using "Base-station Controlled Rate Scheduling", improvements in actually transmitting downlink control information are described in the "3GPP, R1-030177, Downlink physical channel structure" (hereinafter referred to as "Document 3"). This Document 3 describes a method of transmitting downlink control information embedded in a dedicated channel for each communication terminal such as DPDCH (Dedicated Physical Data channel) or DPCCH (Dedicated Physical Control Channel).

FIG.1 shows a configuration example of a radio base station apparatus for realizing this method. First, the transmission system of a radio base station apparatus will be explained. The radio base station apparatus is provided with a plurality of dedicated channel signal formation units 11-1 to 11-N that form transmission signals directed to their respective communication

terminal apparatuses. That is, there are N dedicated channel signal formation units 11-1 to 11-N corresponding to N communication terminals with which they communicate. Since processes of the respective dedicated channel  
5 signal formation units 11-1 to 11-N are the same, the configuration of only one dedicated channel signal formation unit 11-1 will be explained here.

The dedicated channel signal formation unit 11-1 multiplexes a pilot signal (PILOT), transmission data,  
10 uplink channel transmit power control command (UL-TPC), ACK/NACK and RG information through a channel encoding section 12. Before being multiplexed, the transmission data is subjected to error correcting coding. The multiplexed signal is modulated by a modulation section  
15 13 and sent to a spreading section 14.

The spreading section 14 carries out spreading processing on the modulated signal using a spreading code specific to the communication terminal. That is, the dedicated channel signal formation units 11-1 to 11-N  
20 carry out spreading processing using different spreading codes. The spread signal is sent to an amplification section 15. The amplification section 15 increases/decreases power of the spread signal according to a transmit power control signal from a transmit power  
25 control section 16 and sends the amplified signal to a transmission radio section 17.

In this way, the dedicated channel signals specific to the respective communication terminals obtained from

the dedicated channel signal formation units 11-1 to 11-N using different spreading codes are output. The dedicated channel signals are subjected to predetermined radio processing such as analog/digital conversion and up-conversion, etc., by the transmission radio section 17 and transmitted through an antenna 18.

Next, the reception system of the radio base station apparatus 10 will be explained. The radio base station apparatus 10 inputs a signal received from the antenna 18 to a reception radio section 20. The reception radio section 20 carries out predetermined radio processing such as down-conversion and analog/digital conversion on the received signal to obtain a received baseband signal and sends this baseband signal to reception processing units 21-1 to 21-N provided for the N communication terminals. Since processes of the dedicated channel signal formation units 21-1 to 21-N are the same, only the configuration of the dedicated channel signal formation unit 21-1 will be explained here.

A despreading section 22 carries out despreading processing on the received baseband signal using a spreading code corresponding to the communication terminal, extracts a dedicated channel signal sent from the communication terminal apparatus and outputs the dedicated channel signal to a demodulation section 23. Furthermore, the despreading section 22 sends information indicating desired signal power obtained from a delay profile to be created during despreading to an SIR

measuring section 29.

The demodulation section 23 carries out demodulation processing on the output signal of the despreading section 22 and sends the demodulated signal to a channel decoding section 24. The channel decoding section 24 carries out decoding processing such as error correcting decoding on the output signal of the demodulation section 23 and extracts received data, downlink transmit power control command (DL-TPC), etc. The received data is sent to a higher level control station and the DL-TPC is sent to the transmit power control section 16.

The SIR measuring section 29 calculates interference signal power from a variance of the desired signal power, calculates a ratio (SIR) of the desired signal power to the interference signal power and sends information indicating the SIR to the TPC generation section 30 and scheduling section 32. The TPC generation section 30 generates an uplink channel transmit power control command (UL-TPC) for instructing an increase/decrease of transmit power of the uplink channel based on a magnitude relationship between a reception SIR and target SIR of the uplink channel and sends this UL-TPC to the channel encoding section 12.

The scheduling section 32 decides a communication terminal apparatus for which transmission of packet data is allowed based on rate request information (RR information) from each communication terminal apparatus,

the SIR and a reception power margin from the reception power measuring section 31 and decides parameters (coding rate of error correcting coding, modulation multi-value number, spreading factor, transmit power, etc.) during the packet data transmission as RG information (scheduling). Then, the scheduling section 32 sends this RG information to the channel encoding section.

The reception power measuring section 31 calculates a reception power margin based on reception power from the reception radio section 20 and maximum reception power and sends the reception power margin to the scheduling section 32.

A despreading section 25 carries out despreading processing on the received baseband signal using the same spreading factor as that used for spreading the uplink packet data by the communication terminal. Information such as the spreading factor of this uplink packet data, modulation multi-value number, coding rate, etc., is embedded in the signal by the communication terminal and transmitted, and the radio base station apparatus 10 extracts the information embedded in the received data and notifies the despreading section 25, demodulation section 26 and channel decoding section 27 of the information. That is, the despreading section 25, demodulation section 26 and channel decoding section 27 are constructed so as to be able to change the spreading factor, modulation multi-value number and coding rate according to the transmission parameter information from



the communication terminal.

The demodulation section 26 carries out demodulation processing on the packet signal output from the despreading section 25 and sends the demodulated  
5 signal to the channel decoding section 27. The channel decoding section 27 carries out decoding processing such as error correcting decoding on the demodulated signal, extracts received packet data and outputs the packet data to an error detection section 28. Furthermore, the  
10 channel decoding section 27 extracts rate request information (RR information) and sends the rate request information to the scheduling section 32.

The error detection section 28 carries out error detection on the received packet data. When no error is  
15 detected, the error detection section 28 outputs the received packet data to a higher level station and sends an ACK signal indicating that the data has been demodulated correctly to the channel encoding section 12. On the other hand, when an error is detected, the error detection  
20 section 28 sends a NACK signal indicating that the data has not been demodulated correctly to the channel encoding section 12.

FIG.2 shows the configuration of a communication terminal apparatus which communicates with the radio base  
25 station apparatus 10. The communication terminal apparatus 40 inputs a signal received through an antenna 41 to a reception radio section 42. The reception radio section 42 applies down-conversion and analog/digital

conversion processing on the received signal to obtain a received baseband signal and sends this baseband signal to a despreading section 43.

5 The despreading section 43 carries out despreading processing using a spreading code specific to this communication terminal to obtain a signal directed to the own station. The despread signal is subjected to demodulation processing and decoding processing sequentially by a demodulation section 44 and a channel  
10 decoding section 45, and received data, uplink channel transmit power control command (UL-TPC), transmission rate information (RG information) and ACK/NACK are thereby obtained. Furthermore, the despread signal is input to an SIR measuring section 46 and a TPC generation  
15 section 47 sequentially and a downlink transmit power control command (DL-TPC) is thereby obtained from the TPC generation section 47.

Next, the transmission system of the communication terminal apparatus 40 will be explained. While the  
20 communication terminal apparatus 40 changes a coding rate, modulation multi-value number or spreading factor for transmission packet data, the communication terminal apparatus 40 does not change these parameters for other data. More specifically, a pilot signal (PILOT),  
25 downlink signal transmit power control command (DL-TPC) or transmission data is processed by a channel encoding section 50, a modulation section 51 and a spreading section 52 whose coding rate, modulation multi-value number and

spreading factor are fixed respectively and then the spread signal is sent to an amplification section 53.

On the other hand, the transmission packet data is stored in a buffer 54 first. Based on the ACK/NACK, the  
5 buffer 54 erases the transmission packet data transmitted last time and outputs the initial transmission packet data to a channel encoding section 59 in the case of ACK, whereas the buffer 54 outputs the transmission packet data sent last time to the channel encoding section 59  
10 again in the case of NACK.

Furthermore, an amount of transmission packet data stored in the buffer 54 is measured by a data amount measuring section 55 and the data amount measuring section 55 sends the measurement result to a transmission rate  
15 selection section 57 and a rate request selection section 56.

The transmission rate selection section 56 selects a transmission rate at which data is actually transmitted based on the RG information sent from the radio base station  
20 apparatus 10 and extracted from the channel decoding section 45, that is, transmission rate information, amount of data stored in the buffer 54 and transmit power margin and notifies the rate request selection section 56 of the selected transmission rate and also notifies  
25 a transmission parameter setting section 58 of the same.

The rate request selection section 56 generates rate request information (RR information) based on the transmission rate notified from the transmission rate

selection section 57, amount of data stored in the buffer  
54 and transmit power margin and sends the rate request  
information to the channel encoding section 59. This RR  
information is information indicating a transmission rate  
5 of transmission packet data desired by the communication  
terminal apparatus and is expressed by, for example, 1  
to n (n is a natural number of 2 or above).

Based on the transmission rate notified from the  
transmission rate selection section 57, the transmission  
10 parameter setting section 58 controls the reading rate  
of the transmission packet data stored in the buffer 54,  
sets the coding rate at the channel encoding section 59,  
modulation multi-value number at a modulation section  
60 and the spreading factor at a spreading section 61  
15 and sends these transmission parameters to the channel  
encoding section 59, modulation section 60 and spreading  
section 61. Furthermore, based on the transmission rate,  
the transmission parameter setting section 58 sets an  
amount of offset of transmit power when packet data is  
20 transmitted and sends this amount to a transmit power  
control section 63.

The transmit power margin input to the transmission  
rate selection section 57 and rate request selection  
section 56 is set by a transmit power measuring section  
25 65. More specifically, the transmit power measuring  
section 65 sets the transmit power margin based on transmit  
power controlled by a transmit power control section 64  
according to an uplink channel transmit power control

command (UL-TPC) and maximum transmit power that can be transmitted by the own apparatus. The transmit power control section 63 that generates a transmit power control signal of packet data generates a transmit power control  
5 signal which is obtaining by giving an offset set by the transmission parameter setting section 58 to the control signals from the transmit power control section 64 such as other pilot signal, downlink transmit power control command (DL-TPC) and transmit power control signal of  
10 transmission data.

The spread signals output from the spreading section 52 and spreading section 61 are amplified independently by corresponding amplification sections 53, 62, subjected to predetermined radio processing such as digital/analog  
15 conversion and up-conversion by a transmission radio section 66 and transmitted through the antenna 41.

In the conventional radio base station apparatus 10 and communication terminal apparatus 40 having the structures shown in FIG.1 and FIG.2, the radio base station  
20 apparatus 10 transmits control information for uplink packet transmission such as RG information and ACK/NACK embedded in a dedicated channel. The communication terminal apparatus 40 extracts a control signal directed to the own station from the received signal by despread-  
25 ing the received signal using a dedicated spreading code. Then, the communication terminal apparatus 40 decides the transmission rate of transmission packet data or whether retransmission is necessary or not based on this

control signal and forms an uplink packet signal.

FIG.3 shows the states of the respective dedicated channels transmitted from the radio base station apparatus 10. Dedicated channel signals (communication terminal 1 dedicated ch to communication terminal N dedicated ch) directed to the communication terminals 1 to N are formed by the aforementioned dedicated channel signal formation units 11-1 to 11-N. In each dedicated channel, control information for forming uplink packet signals such as RG information and ACK/NACK expressed by shaded areas in the figure is embedded between transmission data. Here, each dedicated channel is spread using a spreading code specific to each communication terminal, and therefore even if a plurality of dedicated channel signals is received at the same time, each communication terminal can extract only the transmission data and control information directed to the own station and can form an uplink packet signal adequately based on the extracted control information.

When control information (downlink control information) for forming an uplink packet signal is transmitted using a method shown in "3GPP, R1-030067, "Reducing control channel overhead for Enhanced Uplink" if information is transmitted only to a selected communication terminal through scheduling as a method called "Base-station Controlled Scheduled Transmission", there should be only the same number of downlink channels for transmitting control information as the selected

communication terminals.

However, when downlink control information is transmitted to all communication terminals simultaneously as in the case of a method called

5 "Base-station Controlled Rate Scheduling", downlink control information channels corresponding in number to all the communication terminals are required. As a result, there is a problem that resources of downlink spreading codes are overconsumed.

10 Furthermore, in the method called "Base-station Controlled Rate Scheduling", even if only control information indicating an increase/decrease of a transmission rate is sent, it is necessary to add numbers for identifying to which communication terminal the

15 control information is directed to the control information. This causes a problem that overhead increases and transmit power resources on a downlink are overconsumed. Furthermore, when downlink transmit power resources are overconsumed, interference with other

20 cells increases, leading to a reduction of a system capacity.

On the other hand, as indicated in "3GPP, R1-030177, Downlink physical channel structure", that is, as is implemented with the configurations shown in FIG.1 and

25 FIG.2, when the downlink control information for forming an uplink packet signal is embedded in a dedicated channel of each communication terminal which is carrying out uplink packet transmission, it is possible to transmit

control information to all communication terminals, but there is also a problem of producing adverse effects on existing dedicated channels. Moreover, transmitting downlink control information embedded in the existing  
5 dedicated channels without errors needs to increase transmit power of the downlink control information, which results in a problem that the downlink transmit power resources are overconsumed.

For example, when control information is embedded  
10 in a data channel called "DPDCH" (channel to mainly transmit speech data and signaling, etc., from a higher level apparatus), the number of bits on a physical channel available for dedicated channel data is decreased, which leads to a problem that the quality of transmission data  
15 deteriorates. Compensating for this quality deterioration requires transmit power of a dedicated channel to be increased.

Furthermore, when control information is embedded in a control channel called "DPCCH", there is a proposal  
20 on assignment of the bit of TFCI (used to notify the receiving side of the data size of a plurality of channels multiplexed in the DPDCH" to this control information. But this also deteriorates the reception performance of TFCI, increasing the probability that reception  
25 processing of dedicated channels will not be performed correctly.

Furthermore, when a standardization specification using dedicated channels is already determined, changing



the standardization specification of a downlink dedicated channel produces another problem that not only a test on uplink channel packet transmission but also a test on dedicated channels needs to be done again.

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#### Disclosure of Invention

It is an object of the present invention to provide a radio base station apparatus, communication terminal apparatus and method of transmitting control information capable of transmitting control information directed to each communication terminal for each communication terminal to transmit uplink packets using a dedicated channel to all communication terminals carrying out uplink packet transmission without transmitting identification information or without changing dedicated channels.

This object can be attained when a radio base station apparatus transmits control information for each communication terminal to transmit uplink packets using a dedicated channel to a plurality of communication terminal apparatuses, by the radio base station apparatus multiplexing control information directed to the plurality of communication terminals based on a multiplexing rule preset between the radio base station apparatus and the communication terminals and spreading the control information using a spreading code common to the communication terminals.

Thus, the radio base station apparatus spreads

control information directed to a plurality of terminals using a spreading code common to the respective communication terminal apparatuses, and can thereby suppress consumption of spreading code resources on a downlink, and the communication terminal apparatuses can extract control information directed to the own station adequately from the multiplexed signal according to the preset multiplexing rule.

The following embodiments will explain improvements to the method of creating preferable multiplexing rules when multiplexing control information. Furthermore, the present invention will propose a diversion of the data structures of existing PICH (Page Indication Channel) or AICH (Acquisition Indication Channel).

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#### Brief Description of Drawings

FIG.1 is a block diagram showing the configuration of a conventional radio base station apparatus;

FIG.2 illustrates the configuration of a conventional communication terminal apparatus;

FIG.3 illustrates frame block diagrams of various conventional dedicated channels;

FIG.4 is a block diagram showing the configuration of a radio base station apparatus according to Embodiment 1 of the present invention;

FIG.5 is a block diagram showing the configuration of a communication terminal apparatus of Embodiment 1;

FIG.6 illustrates states of various channel signals obtained by the radio base station apparatus of Embodiment 1;

FIG.7 illustrates a timing relationship on a  
5 downlink physical channel;

FIG.8 illustrates a PICH frame configuration;

FIG.9 is a table showing a relationship between the number of paging indicators and PICH bit mapping;

FIG.10 is a block diagram showing the configuration  
10 of a control information channel signal formation unit when the PICH data structure is diverted;

FIG.11 is a block diagram showing the configuration of a channel decoding section when the PICH data structure is diverted;

15 FIG.12 is a block diagram showing the configuration of a control information channel signal formation unit of Embodiment 2;

FIG.13 is a block diagram showing characteristic parts of the reception system of a communication terminal  
20 apparatus of Embodiment 2;

FIG.14 is a block diagram showing another configuration of the control information channel-signal formation unit of Embodiment 2;

FIG.15 is a block diagram showing the configuration  
25 of a radio base station apparatus of Embodiment 3;

FIG.16 is a block diagram showing the configuration of a channel encoding section of Embodiment 3;

FIG.17 is a block diagram showing the configuration

of a communication terminal apparatus of Embodiment 3;

FIG.18 is a block diagram showing the configuration of a channel decoding section of Embodiment 3;

FIG.19 is a frame block diagram of each channel for  
5 illustrating the operation of Embodiment 3;

FIG.20 illustrates a timing relationship between PRACH and AICH;

FIG.21 illustrates the configuration of AICH;

FIG.22 illustrates a symbol pattern used as an  
10 acquisition indicator;

FIG.23 illustrates the configuration of a radio base station apparatus of Embodiment 4;

FIG.24 illustrates transmit power of a control information channel signal transmitted from the radio  
15 base station apparatus of Embodiment 4;

FIG.25 illustrates a case where transmit power of a control information channel signal within 1 frame is fixed;

FIG.26 illustrates signaling of physical channel  
20 parameters from a higher level apparatus to a communication terminal and base station, and

FIG.27 illustrates the configuration of a system for setting physical channel parameters according to Embodiment 5 through signaling.

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Best Mode for Carrying out the Invention

With reference now to the attached drawings, embodiments of the present invention will be explained

in detail below.

(Embodiment 1)

FIG.4 illustrates the configuration of a radio base station apparatus according to Embodiment 1 of the present invention. The radio base station apparatus 100 is provided with dedicated channel signal formation units 101-1 to 101-N corresponding in number to communication terminals carrying out communication and a control information channel signal formation unit 110.

The dedicated channel signal formation units 101-1 to 101-N function as a first transmission signal formation section, spread transmission data directed to each communication terminal using a spreading code assigned to each communication terminal and thereby form a dedicated channel signal directed to each communication terminal.

On the other hand, the control information channel signal formation unit 110 functions as a second transmission signal formation section, multiplexes control information directed to each communication terminal for each communication terminal to carry out uplink packet transmission using a dedicated channel based on a multiplexing rule preset between the base station apparatus and each communication terminal, spreads the control information using a spreading code common to the communication terminals in a cell and thereby forms a control information channel signal.

Since processes of the respective dedicated channel signal formation units 101-1 to 101-N are the same, only the configuration of one dedicated channel signal formation unit 101-1 will be explained here. The  
5 dedicated channel signal formation unit 101-1 multiplexes a pilot signal (PILOT), transmission data and uplink channel transmit power control command (UL-TPC) through a channel encoding section 102. Before being multiplexed, the transmission data is subjected to error correcting  
10 coding processing. The multiplexed signal is subjected to modulation processing by a modulation section 103 and then sent to a spreading section 104.

The spreading section 104 carries out spreading processing on the modulated signal using a spreading code  
15 specific to the communication terminal. That is, the respective dedicated channel signal formation units 101-1 to 101-N carry out spreading processing using different spreading codes. The signal subjected to the spreading processing is sent to an amplification section 105. The  
20 amplification section 105 amplifies power of the spread signal according to a transmit power control signal from a transmit power control section 106 and sends the amplified signal to a transmission radio section 107.

Thus, dedicated channel signals specific to the  
25 respective communication terminals formed using different spreading codes are output from the respective dedicated channel signal formation units 101-1 to 101-N.

On the other hand, the control information channel

signal formation unit 110 inputs RG information directed to each communication terminal obtained from a scheduling section 32 to a channel encoding section 111 and inputs ACK/NACK directed to each communication terminal obtained from an error detection section 28. The channel encoding section 111 time-division multiplexes ACK/NACK and RG information directed to each communication terminal at positions predetermined between the base station apparatus and each communication terminal based on timing information. FIG.6 shows this state. The output from the channel encoding section 111 is subjected to modulation processing by a modulation section 112 and sent to a spreading section 113.

The spreading section 113 spreads the modulated signal using a spreading code common to all the communication terminals with which the base station apparatus is communicating. The spread signal is sent to an amplification section 114. The amplification section 114 amplifies power of the spread signal according to a transmit power control signal from a transmit power setting section 115 and sends the amplified signal to the transmission radio section 107.

In this way, the control information channel signal formation unit 110 time-division multiplexes control information (RG information (transmission rate information), ACK/NACK in this embodiment) for each communication terminal to perform uplink packet transmission using a dedicated channel at a timing

determined between the base station apparatus and the communication terminal and outputs a control information channel signal spread using a spreading code common to the communication terminals.

5           The reception system of the radio base station apparatus 100 has a configuration similar to that of the transmission system of the aforementioned radio base station apparatus 10 shown in FIG.1, and therefore the same components are assigned the same reference numerals  
10 in FIG.1 and explanations thereof will be omitted.

          Next, using FIG.5 in which the components corresponding to those in FIG.2 are assigned the same reference numerals, the configuration of a communication terminal apparatus that communicates with the radio base  
15 station apparatus 100 will be explained. Here, explanations of the same components as those in FIG.2 will be omitted.

          The communication terminal apparatus 200 of this embodiment despreads a received baseband signal output  
20 from a reception radio section 42 using a spreading code common to the communication terminals in the cell through a despreding section 201 and thereby extracts a control information channel signal. A despreding section 43 carries out despreding processing using a spreading code  
25 individually assigned to the own station to thereby extract a dedicated channel signal.

          The despread signal output from the despreding section 201 is demodulated by a demodulation section 202



and input to a channel decoding section 203. The channel decoding section 203 extracts control information directed to the own station out of the control information directed to the communication terminals time-division multiplexed on a control information channel, that is, 5 RG information and ACK/NACK based on the timing information. The communication terminal apparatus 200 controls the transmission rate of uplink transmission packet data based on the extracted RG information and 10 controls retransmission of the uplink transmission packet data based on the extracted ACK/NACK.

The transmission system of the communication terminal apparatus 200 has a configuration similar to that of the transmission system of the communication 15 terminal apparatus 40 described above using FIG.2, and therefore the same components as those in FIG.2 are assigned the same reference numerals and explanations thereof will be omitted.

Next, the operations of the radio base station 20 apparatus 100 and communication terminal apparatus 200 of this embodiment will be explained. When transmitting transmission data directed to each communication terminal using a dedicated channel, the radio base station apparatus 100 transmits control information (RG 25 information and ACK/NACK) directed to each communication terminal for each communication terminal to transmit uplink packet transmission using a dedicated channel, using a channel for control information spread using a

spreading code common to the communication terminals.

As a result, even when downlink control information is sent to all communication terminals in communication simultaneously using a method called "Base-station  
5 Controlled Rate Scheduling", it is possible to suppress an increase in the number of channels and save downlink spreading code resources. Furthermore, control information for uplink packet transmission is sent using a channel for control information transmitted through  
10 a second transmission signal formation section which is different from the dedicated channel transmitted through the first transmission signal formation section, and therefore it is possible to avoid reducing the number of bits on a physical channel available for dedicated  
15 channel data and it is possible to avoid quality deterioration of transmission data on the downlink as a consequence. Furthermore, even when a standardization specification using a dedicated channel is already determined, it is possible to transmit control  
20 information for the communication terminal to carry out uplink packet transmission using a dedicated channel without changing the standardization specification of the dedicated channel on the downlink.

In addition, the radio base station apparatus 100  
25 determines a timing for placing control information between the base station apparatus and each communication terminal (that is, determines a multiplexing rule for time-division multiplexing) and time-division

multiplexes control information directed to each communication terminal. As a result, the communication terminal apparatus 200 can extract control information directed to the own station at a predetermined timing from among the time-division multiplexed control information.

Therefore, in transmitting control information directed to all communication terminals through a channel using the same spreading code, it is not necessary to add identification information to identify to which communication terminal the control information is directed, in other words, it is only necessary to transmit control information, and therefore it is possible to avoid an increase of overhead.

Thus, this embodiment time-division multiplexes control information for each communication terminal to carry out uplink packet transmission using a dedicated channel at a position predetermined between the base station apparatus and each communication terminal, spreads and transmits the control information using a spreading code common to the communication terminals, and can thereby realize the radio base station apparatus 100 capable of transmitting control information on uplink packet transmission to all communication terminals carrying out uplink packet transmission without transmitting numbers identifying the communication terminals or without changing dedicated channels.

In addition, the present inventor et al. considered

that it would be possible to divert a PICH (Page Indication Channel) transmission circuit at the base station and a PICH reception circuit at the communication terminal by transmitting the control information time-division multiplexed using an existing PICH data structure as the control information channel and suppress the increase in the circuit scales of the base station and communication terminal. The time-division multiplexing method of control information using the PICH will be explained below.

First, a general PICH will be explained. The PICH is a common channel of a downlink used to predict the existence of paging (ringing indicating arrival of a call). The PICH is broadcast to all communication terminals on standby in the same cell. Each communication terminal is aware of a timing assigned to the own station in the PICH and extracts a paging indicator directed to the own station from the PICH at that timing. FIG.7 shows a timing relationship between the PICH and other downlink physical channels.

More specifically, a paging message is sent through an S-CCPCH (Secondary Common Control Physical Channel) of 10 ms long. When there is a plurality of S-CCPCH channels, the  $k$ th S-CCPCH is sent with a timing offset of  $\tau_{S-CCPCH, k}$  with respect to a P-CCPCH which is a reference timing of the cell. The PICH is transmitted with a timing offset of  $\tau_{PICH}$  with respect to this  $k$ th S-CCPCH.

FIG.8 shows the frame configuration of the PICH. The PICH is a physical channel at a fixed rate (spreading factor SF=256) for transmitting a paging indicator. The PICH always relates to the S-CCPCH which transmits a paging message. The PICH frame consists of 300 bits in 10 ms. Of these bits, 288 bits are used to transmit paging indicators (PI) and the remaining 12 bits correspond to no transmission (DTX).

Of each PICH frame,  $N_p$  paging indicators are time-division multiplexed and transmitted in order of  $\{P_0, \dots, P_{N_p-1}\}$ . Here, the number of paging indicators  $N_p$  within 1 frame is any one of 18, 36, 72 or 144. The information transmitted with one paging indicator is two values of 1/0. The number of bits on the PICH with respect to one paging indicator is  $288/N_p$ . The communication terminal belongs to any one of  $N_p$  groups and receives a paging indicator at the timing of the own group. The timing of the paging indicator is defined by the following expression and randomized so that the timing of each paging indicator in the frame varies from one frame to another.

$$q = \left( PI + \left[ \left( (18 \times (SFN + \lfloor SFN/8 \rfloor + \lfloor SFN/64 \rfloor + \lfloor SFN/512 \rfloor)) \bmod 144 \right) \times \frac{N_p}{144} \right] \right) \bmod N_p$$

In the above expression,  $\lfloor \rfloor$  denotes a drop of the fractional portion, SFN denotes a system frame number of a P-CCPCH radio frame during which the PICH radio frame starts. The bit assignment in the paging indicator for every number of paging indicators  $N_p$  ( $N_p=18, 36, 72, 144$ ) is shown in FIG.9 as a reference. As is also evident from

this figure, the number of repetitive bits in each paging indicator decreases as the number of paging indicators  $N_p$  increases.

This embodiment proposes the following three  
5 methods ①, ② and ③ as the methods for transmitting control information on uplink packet transmission diverting such a PICH data structure:

① One paging indicator is assigned to only one communication terminal so as to realize control for each  
10 communication terminal. This is because assigning the same paging indicator to a plurality of communication terminals of the same paging group prevents control for each communication terminal. Since each paging indicator can transmit two values of 1/0, it is possible  
15 to perform mapping, for example, of +1=up, -1=down as rate control. To realize "keep" of the rate control, it is possible to introduce a no transmission section (DTX). Furthermore, when ACK/NACK of HARQ is transmitted, it is possible to perform mapping of +1=ACK, -1=NACK.

20 ② A plurality of paging indicators is assigned to one communication terminal. This allows control information to be transmitted to one communication terminal for each slot (in other words, a plurality of times per frame), and therefore high-speed control can  
25 be realized. Furthermore, it is also possible to perform control requiring a plurality of bits (e.g., high accuracy rate control using a plurality of bits or both rate control and control of ACK/NACK). Since the timing corresponding

to one paging indicator is once per frame, it is effective to assign a plurality of paging indicators to one communication terminals for high-speed control or control requiring a plurality of bits.

- 5   ③ In the above described expression, suppose  $q=PI$ . This makes the timing at which paging indicator PI is transmitted constant regardless of the frame. This is because with randomization according to the above described expression, the timing at which a paging  
10 indicator directed to the communication terminal is transmitted changes from one frame to another, producing a variation in control intervals.

Thus, transmitting control information using such methods ① to ③ by diverting the existing PICH data  
15 structure allows the PICH transmission circuit at the base station and the PICH reception circuit at the communication terminal to be diverted without adding any new data structure for a new downlink channel, making it possible to suppress an increase in the circuit scales  
20 of the base station and communication terminal.

FIG.10 shows a specific configuration example of the control information channel signal formation unit 110 when the PICH data structure is diverted to time-division multiplex control information directed to  
25 a plurality of communication terminals on an uplink transmission packet signal. Actually, the channel encoding section 111 of the control information channel signal formation unit 110 shown in FIG.4 can be constructed

as the channel encoding section 120 in FIG.10.

The channel encoding section 120 inputs ACK/NACK and RG information directed to each communication terminal to a selection section 121. The selection  
5 section 121 outputs this information sequentially at timings according to timing information predetermined between the base station apparatus and the communication terminal.

A repetition section 122 outputs input data  
10 repeatedly as many times as a predetermined repetition count. This repetition count is determined by the number of paging indicators  $N_p$  as described above, and the process is repeated as many times as the number of bits to be stored in one paging indicator. For example, when the  
15 number of paging indicators  $N_p$  is 18, the process is repeated 16 times and when  $N_p$  is 144, the process is repeated two times.

The control information subjected to the repetition processing is sent to a mapping section 123. The mapping  
20 section 123 performs mapping to transmission bits according to the control information. For example, mapping is performed to -1 when the control information is 1, and to +1 when the control information is 0 (that is, the polarity of the transmission bit is changed  
25 according to the content of the control information). Thus, it is possible to time-division multiplex the control information directed to a plurality of communication terminals on the uplink transmission packet



signals using the same data structure as the existing PICH data structure. When three values should be transmitted, "no transmission" can be used.

FIG.11 shows the configuration of a channel decoding section 210 that decodes the data formed by the channel encoding section 120 in FIG.10. Actually, the channel decoding section 203 shown in FIG.5 can be constructed as the channel decoding section 210 in FIG.11.

The channel decoding section 210 inputs a demodulated signal to a de-repetition section 211. The de-repetition section 211 extracts the paging indicator directed to the own station from among time-division multiplexed paging indicators directed to a plurality of terminals based on the timing information. The de-repetition section 211 also combines bits repeated in the paging indicator based on the repetition count into one bit and outputs the combined bit. The output of the de-repetition section 211 is output to a polarity decision section 212. The polarity decision section 212 decides the polarity of the bit output from the de-repetition section 211 and thereby detects the contents of the control information (RG information and ACK/NACK).

By so doing, it is also possible to transmit control information directed to the plurality of terminals in addition to paging prediction signal using the existing PICH data structure. In order for the communication terminal to identify a paging prediction signal and the

control information directed to the plurality of terminals, it is also possible to change, for example, a spreading code or for the system to determine the times at which the respective signals are transmitted.

5

(Embodiment 2)

This embodiment proposes that spreading codes are changed according to the type of control information taking into consideration the fact that transmitting control information directed to a plurality of communication terminals by diverting the PICH data structure as in the case of Embodiment 1 produces limits to the number of transmittable control information pieces and the number of communication terminals.

15 For example, as shown in FIG.9, in a system with the number of paging indicators  $N_p$  in one frame set to  $N_p=144$ , there are 144 combinations of communication terminals and control information pieces that can be transmitted in one frame, while in a system with  $N_p=18$ ,  
20 the repetition count of bits in a paging indicator increases, and therefore only 18 combinations between communication terminals and control information pieces that can be transmitted in one frame can be secured. Focused on the fact that the number of transmittable  
25 control information pieces or the number of communication terminals decreases extremely depending on the number of paging indicators  $N_p$ , this embodiment designs a configuration that increases the number of transmittable

control information pieces and communication terminals even when a PICH data structure is used.

FIG.12 shows the configuration of a control information channel signal formation unit according to this embodiment. That is, the control information channel signal formation unit 110 shown in FIG.4 is constructed as shown in FIG.12. The control information channel signal formation unit shown in FIG.12 is designed to form a control information channel signal according to the type of control information. In the case of this embodiment, there are two types of control information to be transmitted; ACK/NACK and RG information, and therefore two channel processing systems are provided.

More specifically, ACK/NACKs directed to a plurality of terminals is input to a selection section 131A of a channel encoding section 130 and RG information directed to the plurality of terminals is input to a selection section 131B. The selection sections 131A, 131B output ACK/NACK and RG information directed to the respective communication terminals sequentially at timings according to timing information. The ACK/NACK and RG information output from the selection sections 131A, 131B are repeatedly output by the repetition sections 132A, 132B according to the number of repetitions. The mapping sections 133A, 133B carry out mapping processing according to the contents of the repeatedly output ACK/NACK and RG information (more specifically, the polarity of the output bit is changed according to

the contents), and thereby form and output a PICH bit.

In this way, two lines of PICH bits are formed by the channel encoding section 130. The PICH bits of the respective lines are modulated by modulation sections 112A, 112B respectively and spread by spreading section 113A, 113B using different spreading codes. The spreading code used by the spreading section 113A here is a spreading code common in the cell and the spreading code used by the spreading section 113B is different from the spreading code used by the spreading section 113A but common in the cell. These spreading codes are recognized by communication terminals in the cell.

The spread signals output from the spreading sections 113A, 113B are amplified by amplification sections 114A, 114B whose amplification factors are controlled by transmit power setting sections 115A, 115B respectively and then output to a transmission radio section.

The signal formed by the control information channel signal formation unit in FIG.12 is received by a communication terminal apparatus having the configuration shown in FIG.13. FIG.13 only shows characteristic parts of the reception system provided for the communication terminal of this embodiment and these parts correspond to the despreading section 201, demodulation section 202 and channel decoding section 203 in FIG.5.

The signal output from the reception radio section

42 (FIG.5) are input to despreading sections 201A, 201B. The despreading sections 201A, 201B despread the received baseband signal using the same spreading codes used by the spreading section 113A, 113B respectively (FIG.12).

5 In this way, two lines of PICH signals are separated from the received baseband signal. The respective PICH signals are demodulated by demodulation sections 202A, 202B and sent to channel decoding sections 220A, 220B respectively.

10 The channel decoding sections 220A, 220B extract paging indicators directed to the own station according to timing information from the PICH signals through de-repetition sections 221A, 221B respectively and further apply de-repetition processing according to the  
15 repletion count. Polarity decision sections 222A, 222B decide the polarities of the signals after the de-repetition processing (that is, applies demapping processing) to thereby reconstruct the ACK/NACK and RG information.

20 Thus, this embodiment forms a PICH signal for each type of control information, spreads a number of PICH signals corresponding to the type of control information using spreading codes which are different but common in the cell and sends the spread signals to a plurality of  
25 communication terminals in the cell, and can thereby increase the number of transmittable control information pieces or the number of communication terminals even when a PICH data structure is used. In the case of this

embodiment, it is possible to increase the number of transmittable control information pieces or the number of communication terminals twofold.

5 This embodiment has explained the case where since two types of control information; ACK/NACK and RG information are transmitted to each communication terminal, two lines of PICH signals accommodating these control signals are formed, spread using two spreading codes which are common in the cell and transmitted.

10 However, in the case of, for example, three types of control information, it is possible to form three lines of PICH signals accommodating the respective control signals, spread the PICH signals using three spreading codes which are common in the cell and transmit the spread signals.

15 Furthermore, when the number of control information bits of one communication terminal is  $N$  and the number of spreading codes common in the cell used is  $M$ , it is possible to divide the control signals into portions of  $N/M$  bits each and send them using their respective spreading codes.

20 Furthermore, this embodiment has explained the case where a number of PICH signals corresponding to the type of control information are formed and spread using spreading codes which are different but common in the cell, but the present invention is not limited to this

25 and it is also possible to increase the number of transmittable control information pieces or the number of communication terminals using the configuration shown in FIG.14.

In FIG.14 in which the components corresponding to those in FIG.12 are assigned the same reference numerals, a selection section 141 in a channel encoding section 140 selects and outputs input ACK/NACK and RG information directed to a plurality of terminals based on timing information and code assignment information.

In the configuration in FIG.14 here, when, for example, there are 20 communication terminals in the cell to which control information should be transmitted, a first spreading code is used for 10 communication terminals which is common to these terminals and a second spreading code is used for the remaining 10 communication terminals which is common to these terminals. That is, a plurality of communication terminals in the cell is grouped according to spreading codes and PICH signals are formed group by group.

That is, the selection section 141 divides ACK/NACK and RG information directed to each communication terminal into two lines based on the code assignment information. Furthermore, for the signal of each line, ACK/NACK and RG information directed to the communication terminals in a group are time-division multiplexed based on the timing information and output.

The control information of the respective lines is subjected to repetition processing by repetition sections 142A, 142B and mapped by mapping sections 143A, 143B and thereby output from the channel encoding section 140 as PICH signals.

Thus, according to the configuration in FIG.14, a plurality of communication terminals in the cell is grouped according to spreading codes and a PICH signal for transmitting control information is formed group by group, and it is thereby possible to increase the number of transmittable control information pieces or the number of communication terminals even when a PICH data structure is used as in the case of the aforementioned embodiment. In this case, the number of groups is not limited to 2, either.

(Embodiment 3)

This embodiment proposes a method of transmitting to communication terminals control information on uplink packet transmission multiplexed using signatures. More specifically, this is a method of providing a plurality of symbol patterns which is multiplexed but still separable (that is, mutually uncorrelated or quasi-uncorrelated), assigning one or a plurality of symbol patterns to one communication terminal and changing polarities of the symbol patterns according to the contents of control information to be transmitted.

FIG.15 in which the components corresponding to those in FIG.4 are assigned the same reference numerals shows the configuration of a radio base station apparatus according to Embodiment 3 of the present invention. The radio base station apparatus 300 has a configuration similar to that of the radio base station apparatus 100



in Embodiment 1 except that signature information is input to a channel encoding section 302 and control information of an uplink transmission packet directed to each communication terminal is multiplexed using signatures.

5           The channel encoding section 302 is constructed as shown in FIG.16. The channel encoding section 302 inputs RG information and ACK/NACK directed to each communication terminal to a selection section 303. The selection section 303 outputs information corresponding to the signature information from the input information at a timing based on timing information.

          The channel encoding section 302 also includes a pattern table 304. The pattern table 304 stores a plurality of symbol patterns which have mutually 0 correlations and the pattern table 304 outputs a plurality of symbol patterns corresponding to the signature information at a timing based on the timing information. In the example in FIG.16, the contents of the pattern table 304 are rewritable with the signature information.

20           Each symbol pattern output from the pattern table 304 is input to polarity inversion sections 305-1 to 305-M. The polarity inversion sections 305-1 to 305-M invert the polarities of the input symbol patterns according to the control information (RG information and ACK/NACK) from the selection section 303 or output the symbol patterns with the same polarities or output nothing.

          For example, when the RG information has contents instructing an increase of the transmission rate, the

polarity inversion sections 305-1 to 305-M output symbol patterns without inverting their polarities, whereas when the RG information has contents instructing a decrease of the transmission rate, the polarity inversion sections 305-1 to 305-M output symbol patterns with their polarities inverted. Furthermore, when the contents instruct that the transmission rate should be kept, the polarity inversion sections 305-1 to 305-M output nothing. The outputs from the polarity inversion sections 305-1 to 305-M are multiplexed by a multiplexing section 306 and sent to a modulation section 112 (FIG.15).

Which control signal directed to which communication terminal should be selected by the selection section 303 at which timing is determined according to a rule predetermined between the base station apparatus and each communication terminal. Furthermore, which communication terminal should be assigned to which symbol pattern output from the pattern table 304 and which control information (RG information or ACK/NACK) is assigned is also determined according to the rule predetermined between the base station apparatus and the communication terminal.

Next, using FIG.17 in which the components corresponding to those in FIG.5 are assigned the same reference numerals, the configuration of the communication terminal apparatus which communicates with the radio base station apparatus 300 will be explained. Except that the configuration of a channel decoding

section 401 is different, this communication terminal apparatus 400 has a configuration similar to that of the communication terminal apparatus 200 of Embodiment 1. The channel decoding section 401 is designed to extract  
5 control information directed to the own station out of control information directed to a plurality of communication terminals multiplexed on the control information channel based on signature information and timing information.

10 FIG.18 shows the configuration of the channel decoding section 401. The channel decoding section 401 inputs a demodulated signal of the control information channel to a pattern identification section 402. The pattern identification section 402 finds a correlation  
15 between the demodulated signal and symbol pattern specific to the own station based on the signature information (preset information indicating the symbol pattern specific to the own station) to thereby identify and extract the symbol pattern directed to the own station  
20 from among the multiplexed symbol patterns directed to various communication terminals.

Next, the channel decoding section 401 decides the polarity of the extracted symbol pattern through a polarity decision section 403 to detect the contents of  
25 RG information and ACK/NACK. With respect to the RG information, for example, the polarity decision section 403 outputs RG information indicating that the transmission rate should be increased if the polarity

of the symbol pattern is positive, that the transmission rate should be decreased if the polarity is negative, and that the transmission rate should be kept if the correlation result is 0 or equal to or lower than a certain level.

Next, the operations of the radio base station apparatus 300 and communication terminal apparatus 400 of this embodiment will be explained using FIG.19. As in the case of the radio base station apparatus 100 of Embodiment 1, the radio base station apparatus 300 sends transmission data directed to each communication terminal through a dedicated channel, while the radio base station apparatus 300 sends control information directed to each communication terminal (e.g., RG information, ACK/NACK) for each communication terminal to carry out uplink packet transmission using a dedicated channel through a control information channel (downlink control information channel).

In this case, the radio base station apparatus 300 multiplexes control signals directed to communication terminals to which data is transmitted at least at the same time with mutually uncorrelated symbol patterns assigned thereto. At this time, the radio base station apparatus 300 changes the polarity of the symbol pattern according to the contents of control information directed to each communication terminal.

In the example shown in FIG.19, at time T1, symbol pattern 1 (Sig.1) is assigned to communication terminal

1 and at the same time symbol pattern M (Sig.M) is assigned to communication terminal N and these symbol patterns are multiplexed with their polarities changed according to the control information to be transmitted.

5 Furthermore, at time T2, symbol pattern 1 (Sig.1), symbol pattern 2 (Sig.2) and symbol pattern 3 (Sig.3) are assigned to communication terminal 2 and symbol pattern M (Sig.M) is assigned to communication terminal N and these symbol patterns are multiplexed with their polarities changed  
10 according to the control information to be transmitted.

Since the communication terminal which receives this signal is designed to be able to know that symbol patterns 1, 2, 3 are assigned to communication terminal 2 at, for example, time T2 from the timing information  
15 and signature information, it is possible to extract only control information directed to the own station.

As a result, control information directed to all communication terminals is transmitted using one control information channel as with Embodiment 1, and therefore  
20 it is possible to transmit control information for the communication terminals to perform uplink packet transmission using dedicated channels without changing the standardization specification of downlink dedicated channels.

25 In addition, providing a plurality of symbol patterns, assigning one or a plurality of symbol patterns to one communication terminal and changing polarities of the symbol patterns according to the contents of control

information to be sent and thereby multiplexing control information directed to each communication terminal eliminates the need for adding identification information for extracting signals directed to the own station from the multiplexed signal and avoid an increase of overhead.

Thus, this embodiment multiplexes control information for each communication terminal to perform uplink packet transmission using dedicated channels using symbol patterns predetermined between the base station apparatus and the respective communication terminals and spreads the control information using a spreading code common to the communication terminals, and can thereby realize the radio base station apparatus 300 capable of transmitting the control information to all communication terminals carrying out uplink packet transmission without transmitting numbers for identifying communication terminals or changing dedicated channels.

This embodiment has described the case where control information for uplink packet transmission is multiplexed on a control information channel using not only signatures but also timing, but this embodiment may also be adapted so as to perform multiplexing using only signatures. For example, if symbol pattern 1 is assigned to communication terminal 1, symbol pattern 2 is assigned to communication terminal 2 ·····, symbol pattern 3 is assigned to communication terminal N all the time, that is, if time-division multiplexing processing is not performed, it is possible for each communication terminal to extract

control information directed to the own station without timing information.

However, as shown in FIG.19, if timing as well as signature is used, it is possible to perform control requiring a plurality of bits (e.g., high accuracy rate control using a plurality of bits, or both rate control and control of ACK/NACK) simultaneously. The communication terminal 2 corresponds to this in the figure.

10 In addition, this embodiment proposes the use of an existing AICH (Acquisition Indication Channel) data structure as one of preferable methods for transmitting control information on uplink packet transmission directed to a plurality of terminals multiplexed using signatures. The method of multiplexing control  
15 information using the AICH will be explained below.

First, a general AICH will be explained. The AICH is sent from a base station in response to a preamble sent from a communication terminal through a PRACH  
20 (Physical Random Access Channel). FIG.20 shows a timing relationship between PRACH and AICH viewed from a communication terminal. The communication terminal transmits preambles at intervals of  $\tau_{p-p}$ . The base station which has detected a preamble sends an acquisition indicator as a response to the detected preamble. The  
25 time interval between the preamble and acquisition indicator is  $\tau_{p-a}$ . The communication terminal which has received the acquisition indicator meaning permission

for message transmission (ACK) sends a message at intervals of  $\tau_{p-m}$  in response to the preamble.

The AICH sends an acquisition indicator at a fixed rate (spreading factor  $SF=256$ ). As shown in FIG.7, access slot #0 of the AICH starts simultaneously with a P-CCPCH frame which becomes  $(SFN \text{ modulo } 2) = 0$ . Access slots are repeated at 15 periods of #0 to #14.

FIG.21 shows the configuration of the AICH. Each access slot (AS#0 to AS#14) consists of 5120 chips (=2 slots) and each access slot transmits an acquisition indicator expressed in 32 symbols with first 4096 chips and the remaining 1024 chips correspond to no transmission.

The acquisition indicator directed to each communication terminal is assigned one of a plurality of symbol patterns (16 types in the case of FIG.22). For example, the symbol pattern of  $s=0$  in the figure is assigned to a communication terminal and the symbol pattern of  $s=1$  in the figure is assigned to another communication terminal.

The information in one acquisition indicator is actually obtained by multiplying 32 assigned symbol patterns  $b_{s,0}, \dots, b_{s,31}$  by any one of three values  $+1/-1/0$  according to the information to be transmitted. This makes it possible to transmit information of three values using polarities of symbol patterns.

For example, when a symbol pattern with signature number  $s=0$  is assigned to a communication terminal to



transmit information of +1, the symbol pattern is transmitted as is. On the other hand, to transmit information of -1, symbols are transmitted with polarities of all symbol patterns with signature number s=0 in the figure inverted. The same applies to a case where symbol patterns with other signature number s are assigned to other communication terminals.

This embodiment proposes the following three methods ①, ② and ③ as the method of transmitting control information on uplink packet transmission by diverting such an AICH data structure.

① One combination of an access slot (timing) and signature is assigned to only one communication terminal. This allows control for each communication terminal to be realized. Since the above described acquisition indicator can transmit three values of +1/-1/0, it is possible to perform mapping such as +1=up, -1=down, 0=keep, as rate control. Furthermore, when ACK/NACK of HARQ is transmitted, it is possible to perform mapping such as +1=ACK, -1=NACK.

② A plurality of access slots is assigned to one communication terminal. This allows control information to be transmitted to one communication terminal a plurality of times per frame, and can thereby realize high-speed control. Moreover, it is also possible to realize control requiring a plurality of bits (e.g., high accuracy rate control using a plurality of bits and both rate control and control of ACK/NACK).

③ A plurality of symbol patterns is assigned to one communication terminal. This allows control requiring a plurality of bits (e.g., high accuracy rate control using a plurality of bits and both rate control and control of ACK/NACK) to be performed simultaneously. The assignment for communication terminal 2 in the example in FIG.19 corresponds to this.

Thus, diverting the existing AICH data structure and transmitting control information using the methods such as ① to ③ makes it possible to divert the AICH transmission circuit at the base station and AICH reception circuit at the communication terminal without adding downlink channels of a new data structure and suppress an increase in the circuit scales of the base station and communication terminal.

When the AICH data structure is diverted as in this embodiment, there are also limits to the number of transmittable control information pieces and the number of communication terminals as described in Embodiment 2. That is, these numbers are limited to combinations of the number of access slots and the number of signatures of the AICH.

With consideration given to this, carrying out similar processing to that explained in Embodiment 2 in the case where the AICH data structure is diverted is also effective in increasing the number of transmittable control information pieces and the number of communication terminals.

That is, by forming an AICH signal for each type of control information, spreading AICH signals corresponding to the types of control information and the total number of bits using spreading codes which are different but common in the cell and transmitting the AICH signals to a plurality of communication terminals in the cell, it is possible to increase the number of transmittable control information pieces or the number of communication terminals even when the AICH data structure is used.

Furthermore, by grouping a plurality of communication terminals according to spreading codes and forming an AICH signal group by group, it is also possible to increase the number of transmittable control information pieces or the number of communication terminals even when the AICH data structure is used.

(Embodiment 4)

FIG.23 in which the components corresponding to those in FIG.4 are assigned the same reference numerals shows the configuration of a radio base station apparatus according to Embodiment 4 of the present invention. A control information channel signal formation unit 501 of the radio base station apparatus 500 is provided with an average power calculation section 502.

The average power calculation section 502 calculates average transmit power for each dedicated channel based on transmit power control values from

transmit power control sections 106 of dedicated channel  
signal formation units 101-1 to 101-N. For example, an  
average transmit power value within one frame is  
calculated for each dedicated channel. Then, the average  
5 power calculation section 502 gives an offset to the  
average transmit power value for each calculated  
dedicated channel and sends it to a transmit power setting  
section 503.

The transmit power setting section 503 selects the  
10 average transmit power value of any one channel from among  
average transmit power values of a plurality of dedicated  
channels input from the average power calculation section  
502 according to timing information and sends a transmit  
power control signal having a value corresponding to this  
15 average transmit power value to an amplification section  
114. This causes the transmit power value of the control  
signal directed to each communication terminal output  
from the control information channel signal formation  
unit 501 to have magnitude corresponding to the transmit  
20 power value of each dedicated channel.

FIG.24 shows the control information channel signal  
(downlink control information channel) transmitted from  
the radio base station apparatus 500 of this embodiment.  
As described in Embodiment 1, control information  
25 directed to each communication terminal (e.g., RG  
information, ACK/NACK) is time-division multiplexed at  
a timing predetermined between the radio base station  
apparatus and each communication terminal apparatus so

that each communication terminal can extract control information directed to the own station without identification information.

In addition, the magnitude of control information  
5 directed to each communication terminal is controlled so as to match the transmit power value at the dedicated channel directed to the corresponding communication terminal (however, provided with an offset). This control can be realized by the transmit power setting  
10 section 503 matching the amplification factor of the amplification section 114 with the average transmit power value of the dedicated channel of the communication terminal 1 based on the timing information when, for example, the control information directed to the  
15 communication terminal 1 is input to the amplification section 114.

For comparison, FIG.25 shows a state of transmit power of a control information channel signal (e.g., output signal from the control information channel signal  
20 formation unit 110 of the radio base station apparatus 100 of Embodiment 1) when transmit power control according to a dedicated channel is not performed for each control information piece directed to each communication terminal. As is evident from this figure, unless transmit power  
25 control according to this embodiment is performed, transmit power of a control signal directed to each communication terminal is fixed within 1 frame.

On the other hand, this embodiment controls transmit

power of control signals directed to their respective communication terminals which are time-division multiplexed on a control information channel in accordance with the transmit power of the corresponding dedicated channel, and can thereby transmit the control signal directed to each communication terminal to the target communication terminal with high quality and improve reliability of uplink packet transmission. Furthermore, this embodiment can avoid the necessity for overconsuming resources of transmit power and use the saved transmit power resources for other channels.

Thus, in addition to the configuration of Embodiment 1, this embodiment controls transmit power of control signals directed to their respective communication terminals which are time-division multiplexed on a control information channel in accordance with the transmit power of the corresponding dedicated channel, and can thereby realize the radio base station apparatus 500 capable of improving reliability of a control signal directed to each communication terminal and improving the utilization efficiency of transmit power resources in addition to the effects of Embodiment 1.

This embodiment has described the case where transmit power of control information directed to each communication terminal time-division multiplexed as in the case of Embodiment 1 is controlled according to the transmit power of the dedicated channel signal directed to the corresponding communication terminal, but the

present invention is not limited to this and it is also possible to attain effects similar to those in the above described embodiment by controlling transmit power of control information directed to the respective  
5 communication terminals multiplexed using signatures as shown in Embodiment 3 in accordance with the transmit power of the dedicated channel signal directed to the corresponding communication terminal. Furthermore, this embodiment averages transmit power of respective  
10 communication terminals, but it is also possible to use instantaneous transmit power instead of averaged transmit power.

(Embodiment 5)

15 This embodiment will describe an improvement in the method of setting timing information and signature information which need to be shared between the radio base station apparatus and communication terminal apparatus in aforementioned Embodiments 1 to 4.  
20 Furthermore, this embodiment will also describe a setting of spreading code information (channelization code information, scrambling code information) which needs to be shared between the radio base station apparatus and communication terminal apparatus in addition to the  
25 timing information and signature information. In the following explanations, the timing information, signature information and spreading code information will be collectively referred to as "physical channel

parameters."

This embodiment sets the physical channel parameters through signaling from a higher level apparatus such as a radio network control station. FIG.27  
5 shows a system configuration to realize this setting.

The physical channel parameters are generated by a radio network control station (RNC) 600 which is a higher level apparatus of a base station 700. These physical channel parameters are converted to control signals for  
10 controlling parameters of the base station 700 by an NBAP (Node B Application Part) 604 and then sent to a physical layer (PHY) 701 of the base station 700. In this way, the physical channel parameters are set in the physical layer (PHY) 701 of the base station 700.

15 Furthermore, the physical channel parameters generated in the radio network control station 600 are passed through an RRC (Radio Resource Control) 603, RLC (Radio Link Control) 601 and MAC (Medium Access Control) 602 of the radio network control station 600 one by one,  
20 converted to data applicable to the physical layer 701 of the base station 700 and then transmitted from the physical layer 701 of the base station 700 to a physical layer 803 of the communication terminal 800 by radio.

These physical channel parameters are passed  
25 through a MAC 802, RLC 801 and RRC 804 of the communication terminal 800 one by one, converted to control signals for controlling parameters of the physical layer 803 and then sent to the physical layer 803. In this way, the



physical channel parameters are set in the physical layer 803 of the communication terminal 800.

In this way, as shown in FIG.26, the same physical channel parameters are transmitted from the radio network control station 600 to both the base station 700 and communication terminal 800 and these physical channel parameters are set in the physical layers 701, 803 of the respective apparatuses.

Thus, as in the case of Embodiments 1 to 4, this embodiment presets a multiplexing rule between a radio base station and each communication terminal, and in constructing a radio communication system in which the radio base station multiplexes the control information directed to a plurality of communication terminals according to the multiplexing rule, spreads the multiplexed control information using a spreading code common to the respective communication terminals, transmits the spread control information by radio, and the communication terminal despreads the received signal using the common spreading code and extracts the control information directed to the own station according to the multiplexing rule from the despread signal, this embodiment causes the multiplexing rule (physical channel parameters) which needs to be shared between the radio base station apparatus and communication terminal apparatus to be transmitted to the base station 700 and communication terminal 800 through signaling from the higher level apparatus such as the radio network control

station 600, and can thereby set the multiplexing rule easily.

As in the case of Embodiment 1 where the configuration of the PICH physical channel is used as is, a channelization code is set as timing information (number of paging indicator) and spreading code information. This is because when the standardization specification stipulates that a scrambling code is the same as a P-CPICH, the scrambling code need not be set additionally.

Furthermore, as in the case of Embodiment 3 where the configuration of the AICH physical channel is used as is, a channelization code is set as signature information (signature number), timing information (access slot number) and spreading code information. If the standardization specification stipulates that a scrambling code is the same as a P-CPICH, the scrambling code need not be set additionally in this case, either.

#### 20 (Other Embodiments)

The above described embodiments have described RG information for controlling the transmission rate of uplink packet transmission and ACK/NACK for controlling retransmission as an example of control information for each communication terminal to perform uplink packet transmission using a dedicated channel and described the case where this RG information and ACK/NACK are sent from the radio base station apparatus to the communication

terminal apparatus, but the above described control information is not limited to this.

The control information may also be, for example, transmit power of an uplink dedicated channel packet, coding rate of an uplink dedicated channel packet, modulation scheme of uplink dedicated channel packets, number of spreading codes of uplink dedicated channel packets, data size of uplink dedicated channel packets and effects similar to those in the above described embodiments can also be obtained when such control information is transmitted.

Embodiment 2 and Embodiment 3 described above have explained the method for forming a control information channel according to each type of control information and total number of bits and the method for grouping communication terminals in the cell and forming a control information channel for each piece of control information of each group as the method for increasing the number of transmittable control information pieces or the number of communication terminals when a PICH data structure is diverted and when an AICH data structure is diverted, but these methods are not limited to cases where the PICH data structure is diverted or AICH data structure is diverted, and can also be widely used when control information for transmitting uplink packets of a plurality of communication terminals is multiplexed and transmitted.

In the above described embodiments, control

information is not subjected to error correcting coding,  
but the present invention can also be adapted so as to  
carry out error correcting coding and then multiplex the  
control information on the aforementioned control  
5 information channel and transmit the multiplexed control  
information.

Furthermore, when the PICH data structure is  
diverted and when the AICH data structure is diverted,  
a no transmission section necessarily exists in terms  
10 of the data structure, and control information can also  
be transmitted using this no transmission section.

The present invention is not limited to the above  
described embodiments, but can be implemented modified  
in various ways.

15 A mode of the radio base station apparatus of the  
present invention comprises a first transmission signal  
formation section that forms dedicated channel signals  
directed to a plurality of communication terminals by  
spreading transmission data directed to each  
20 communication terminal using a spreading code assigned  
to each communication terminal and a second transmission  
signal formation section that forms transmission signals  
directed to a plurality of communication terminals by  
multiplexing control information directed to each  
25 communication terminal for each communication terminal  
to carry out uplink packet transmission using a dedicated  
channel based on a multiplexing rule preset between the  
base station apparatus and each communication terminal

and spreading the control information using a spreading code common to the respective communication terminals.

According to this configuration, instead of embedding control information for uplink packet transmission in a dedicated channel, the second transmission signal formation section is provided apart from the first transmission signal formation section that forms the dedicated channel signal so as to multiplex and transmit the control information through this second transmission signal formation section, and therefore it is possible to transmit control information for uplink packet transmission without changing the processing of the existing first transmission signal formation section (that is, without changing the existing dedicated channel). Furthermore, the second transmission signal formation section multiplexes control information directed to each communication terminal based on a multiplexing rule predetermined between the base station apparatus and each communication terminal, and therefore once a multiplexing rule is set, the communication terminal can extract control information directed to the own station from among the control information multiplexed according to the multiplexing rule. As a result, it is not necessary to add identification information indicating to which communication terminal the control information is directed every time the control information is transmitted, and it is possible to thereby reduce an amount of information transmitted on a downlink

by the amount corresponding to the saved control information. Furthermore, the second transmission signal formation section spreads the multiplexed control information using a spreading code common to the communication terminals, and can thereby save spreading code resources.

According to another mode of the radio base station apparatus of the present invention, the second transmission signal formation section time-division multiplexes the control information directed to each communication terminal at a position predetermined between the base station apparatus and each communication terminal.

According to this configuration, if timing information on time-division multiplexing is set as a multiplexing rule between the radio base station apparatus and each communication terminal, the radio base station apparatus can easily multiplex control information directed to each communication terminal according to the timing information and the communication terminal can extract control information directed to the own station according to the timing information.

According to a further mode of the radio base station apparatus of the present invention, the second transmission signal formation section diverts a PICH (Page Indication Channel) data structure, assigns the control information to the bit of the paging indicator disposed through a PICH on a time-division basis and

thereby time-division multiplexes the control signal directed to each communication terminal.

According to this configuration, the existing PICH data structure is diverted and control information is time-division multiplexed and transmitted, and therefore it is possible to divert a PICH transmission circuit at the base station and a PICH reception circuit at the communication terminal and suppress an increase in the circuit scales of the base station and communication terminal.

According to a still further mode of the radio base station apparatus of the present invention, the second transmission signal formation section assigns symbol patterns which vary from one communication terminal to another from among a plurality of symbol patterns, changes the polarities of the assigned symbol patterns according to the contents of the corresponding control signals to thereby multiplex the control information directed to each communication terminal.

According to this configuration, if a symbol pattern specific to the own station is set in a communication terminal, the communication terminal can extract only the symbol pattern of the own station from symbol patterns directed to a plurality of multiplexed communication terminals and know the contents of the control information directed to the own station by deciding the polarity of the extracted symbol pattern. Furthermore, it is possible to extend the time for transmitting 1-bit control

information compared to a case with time-division multiplexing and thereby increase resistance to variations in a propagation path such as fading.

According to a still further mode of the radio base station apparatus of the present invention, the second transmission signal formation section diverts an AICH (Acquisition Indication Channel) data structure and multiplexes the control information directed to each communication terminal using this AICH signature.

According to this configuration, an existing AICH data structure is diverted and control information is multiplexed using signature and transmitted, and therefore it is possible to divert an AICH transmission circuit at the base station and AICH reception circuit at the communication terminal and suppress an increase in the circuit scales of the base station and communication terminal.

A still further mode of the radio base station apparatus of the present invention further comprises a first transmit power control section that controls transmit power of a dedicated channel signal formed by the first transmission signal formation section for each dedicated channel and a second transmit power control section that controls transmit power of control information directed to each communication terminal multiplexed by the second transmission signal formation section in accordance with the transmit power of the corresponding dedicated channel.



According to this configuration, not all control signals directed to a plurality of multiplexed communication terminals are equalized, but differentiated by the second transmit power control section according to the condition of the propagation path to/from each communication terminal, which not only improves reliability of the control signal directed to each communication terminal but also improves the utilization efficiency of transmit power resources. Furthermore, interference with other cells can also be suppressed.

According to a still further mode of the radio base station apparatus of the present invention, the second transmission signal formation section comprises a first spreading section that spreads first control information directed to each communication terminal using a first spreading code common to the communication terminals and a second spreading section that spreads second control information directed to each communication terminal using a second spreading code common to the communication terminals.

According to this configuration, when control information directed to a plurality of communication terminals is transmitted by diverting a PICH or AICH data structure, a spreading code (channelization code or scrambling code) is changed according to the type of control information considering that there are limits to the number of transmittable control information pieces

and the number of communication terminals. For example, a first spreading code common to the communication terminals is used for information (RG information) specifying the transmission rate and a second spreading  
5 code common to the communication terminals is used for ACK/NACK. As a result, it is possible to increase the number of transmittable control information pieces and the number of communication terminals even when a PICH or AICH data structure is diverted.

10 According to a still further mode of the radio base station apparatus of the present invention, the second transmission signal formation section divides a plurality of communication terminals carrying out uplink packet transmission into at least two groups and comprises a  
15 first spreading section that spreads the control information directed to the communication terminals of the first group using a first spreading code common to the first group communication terminals and a second spreading section that spreads the control information  
20 directed to the communication terminals of the second group using a second spreading code common to the second group communication terminals.

According to this configuration, when control information directed to a plurality of communication  
25 terminals by diverting a PICH or AICH data structure, the communication terminals are grouped in consideration of the number of transmittable control information pieces and the number of communication terminals and spreading

codes (channelization codes or scrambling codes) are changed group by group. For example, when there are 20 communication terminals to which the control information is to be transmitted in the cell, a first spreading code  
5 common to 10 communication terminals is used for these communication terminals and a second spreading code common to other 10 communication terminals is used for these communication terminals. As a result, even when a PICH or AICH data structure is diverted, it is possible  
10 to increase the number of transmittable control information pieces and the number of communication terminals as appropriate.

A mode of the communication terminal apparatus of the present invention comprises a despreading section  
15 that despreads a signal received from a radio base station apparatus using a spreading code common in a cell, a channel decoding section that extracts control information directed to the own station from the control information directed to a plurality of communication terminals  
20 multiplexed in the despread signal based on a multiplexing rule preset between the communication terminal apparatus and the radio base station apparatus, and a transmission signal formation section that controls the transmission rate of transmission packet data, coding rate, spreading  
25 factor, number of spreading codes, modulation scheme, packet data size, transmit power or retransmission to form an uplink transmission packet based on the extracted control information.

A mode of the method of transmitting control information according to the present invention is a method for a radio base station to transmit control information to a plurality of communication terminals in a cell so that each communication terminal forms an uplink transmission packet signal using a dedicated channel, comprising the steps of presetting a multiplexing rule between the radio base station and each communication terminal, the radio base station multiplexing the control information directed to a plurality of communication terminals according to the multiplexing rule, spreading the multiplexed control information using a spreading code common to the communication terminals and transmitting the control information by radio, and the communication terminal despread a received signal using the common spreading code and extracting the control information directed to the own station from the despread signal according to the multiplexing rule.

A mode of the radio communication system of the present invention comprises a radio base station apparatus that multiplexes control information directed to a plurality of communication terminals according to a multiplexing rule preset between the base station apparatus and the plurality of communication terminals, spreads the multiplexed control information using a spreading code common to the communication terminals and transmits the spread control information by radio and communication terminal apparatuses that despread the

received signal using the common spreading code, extract the control information directed to the own station from the despread signal according to the multiplexing rule and form an uplink packet signal to be transmitted based  
5 on the extracted control information using a dedicated channel.

Another mode of the radio communication system of the present invention sets a multiplexing rule for the radio base station apparatus and communication terminal  
10 apparatuses according to signaling from a higher level apparatus.

As described above, the present invention can transmit control information to all communication terminals carrying out uplink packet transmission in  
15 order for the communication terminals to form an uplink transmission packet signal without transmitting identification information for identifying the communication terminals and without changing dedicated channels.

20

This application is based on the Japanese Patent Application No. 2003-135117 filed on May 13, 2003, entire content of which is expressly incorporated by reference herein.

25

#### Industrial Applicability

The present invention is preferably applicable to a radio communication system made up of radio

communication terminals such as cellular phone sets and  
a base station.

[FIG.1]

10 RADIO BASE STATION APPARATUS

TRANSMISSION DATA

12 CHANNEL ENCODING SECTION

5 13 MODULATION SECTION

14 SPREADING SECTION

16 TRANSMIT POWER CONTROL SECTION

17 TRANSMISSION RADIO SECTION

RG INFORMATION

10 RR INFORMATION

32 SCHEDULING SECTION

RECEPTION POWER MARGIN

31 RECEPTION POWER MEASURING SECTION

MAXIMUM RECEPTION POWER

15 30 TPC GENERATION SECTION

29 SIR MEASURING SECTION

24 CHANNEL DECODING SECTION

RECEIVED DATA

23 DEMODULATION SECTION

20 22 DESPREADING SECTION

20 RECEPTION RADIO SECTION

28 ERROR DETECTION SECTION

27 CHANNEL DECODING SECTION

26 DEMODULATION SECTION

25 25 DESPREADING SECTION

RECEIVED PACKET DATA

RR INFORMATION

[FIG.2]

65 TRANSMIT POWER MEASURING SECTION  
TRANSMIT POWER MARGIN  
MAXIMUM TRANSMIT POWER

5 57 TRANSMISSION RATE SELECTION SECTION  
56 RATE REQUEST SELECTION SECTION  
RG INFORMATION  
63 TRANSMIT POWER CONTROL SECTION  
OFFSET AMOUNT

10 58 TRANSMISSION PARAMETER SETTING SECTION  
55 DATA AMOUNT MEASURING SECTION  
61 SPREADING SECTION  
60 MODULATION SECTION  
59 CHANNEL ENCODING SECTION

15 RR INFORMATION  
54 BUFFER  
TRANSMISSION PACKET DATA  
66 TRANSMISSION RADIO SECTION  
52 SPREADING SECTION

20 51 MODULATION SECTION  
50 CHANNEL ENCODING SECTION  
TRANSMISSION DATA  
64 TRANSMIT POWER CONTROL SECTION  
42 RECEPTION RADIO SECTION

25 43 DESPREADING SECTION  
46 SIR MEASURING SECTION  
44 DEMODULATION SECTION  
47 TPC GENERATION SECTION



45 CHANNEL DECODING SECTION

RECEIVED DATA

RG INFORMATION

40 COMMUNICATION TERMINAL APPARATUS

5

[FIG.3]

COMMUNICATION TERMINAL N DOWNLINK CONTROL INFORMATION

(RG INFORMATION, ACK/NACK, etc.)

COMMUNICATION TERMINAL N DEDICATED CHANNEL DATA

10 COMMUNICATION TERMINAL N DEDICATED CHANNEL

COMMUNICATION TERMINAL 2 DEDICATED CHANNEL

COMMUNICATION TERMINAL 1 DEDICATED CHANNEL

TIME

1 FRAME

15

[FIG.4]

100 RADIO BASE STATION APPARATUS

TRANSMISSION DATA

102 CHANNEL ENCODING SECTION

20 103 MODULATION SECTION

104 SPREADING SECTION

106 TRANSMIT POWER CONTROL SECTION

107 TRANSMISSION RADIO SECTION

TIMING INFORMATION

25 111 CHANNEL ENCODING SECTION

115 TRANSMIT POWER SETTING SECTION

113 SPREADING SECTION

112 MODULATION SECTION

RG INFORMATION  
 RR INFORMATION  
 32 SCHEDULING SECITON  
 RECEPTION POWER MARGIN  
 5 31 RECEPTION POWER MEASURING SECTION  
 MAXIMUM RECEPTION POWER  
 30 TPC GENERATION SECTION  
 29 SIR MEASURING SECTION  
 24 CHANNEL DECODING SECTION  
 10 RECEIVED DATA  
 23 DEMODULATION SECTION  
 22 DESPREADING SECTION  
 20 RECEPTION RADIO SECTION  
 28 ERROR DETECTION SECTION  
 15 27 CHANNEL DECODING SECITON  
 26 DEMODULATION SECTION  
 25 DESPREADING SECTION  
 RECEIVED PACKET DATA  
 RR INFORMATION  
 20  
 [FIG.5]  
 65 TRANSMIT POWER MEASURING SECTION  
 TRANSMIT POWER MARGIN  
 MAXIMUM TRANSMIT POWER  
 25 57 TRANSMISSION RATE SELECTION SECTION  
 56 RATE REQUEST SELECTION SECTION  
 RG INFORMATION  
 63 TRANSMIT POWER CONTROL SECTION

## OFFSET AMOUNT

58 TRANSMISSION PARAMETER SETTING SECTION

55 DATA AMOUNT MEASURING SECTION

61 SPREADING SECTION

5 60 MODULATION SECTION

59 CHANNEL ENCODING SECTION

## RR INFORMATION

54 BUFFER

## TRANSMISSION PACKET DATA

10 66 TRANSMISSION RADIO SECTION

52 SPREADING SECTION

51 MODULATION SECTION

50 CHANNEL ENCODING SECTION

## TRANSMISSION DATA

15 64 TRANSMIT POWER CONTROL SECTION

42 RECEPTION RADIO SECTION

43 DESPREADING SECTION

46 SIR MEASURING SECTION

44 DEMODULATION SECTION

20 47 TPC GENERATION SECTION

45 CHANNEL DECODING SEC DTION

## RECEIVED DATA

201 DESPREADING SECTION

202 DEMODULATION SECTION

25 203 CHANNEL DECODING SEC DTION

## RG INFORMATION

## TIMING INFORMATION

200 COMMUNICATION TERMINAL APPARATUS

[FIG.6]

COMMUNICATION TERMINAL 1 DOWNLINK CONTROL INFORMATION  
(RG INFORMATION, ACK/NACK, etc.)

5 COMMUNICATION TERMINAL 2 DOWNLINK CONTROL INFORMATION  
(RG INFORMATION, ACK/NACK, etc.)

COMMUNICATION TERMINAL N DOWNLINK CONTROL INFORMATION  
(RG INFORMATION, ACK/NACK, etc.)

DOWNLINK CONTROL INFORMATION CHANNEL

10 COMMUNICATION TERMINAL N DEDICATED CHANNEL

COMMUNICATION TERMINAL N DEDICATED CHANNEL DATA

COMMUNICATION TERMINAL 2 DEDICATED CHANNEL

COMMUNICATION TERMINAL 1 DEDICATED CHANNEL

TIME

15 1 FRAME

[FIG.7]

ACCESS SLOT

SUBFRAME

20 SUBFRAME #0 SUBFRAME #1 SUBFRAME #2 SUBFRAME #3 SUBFRAME  
#4

[FIG.8]

288 bits (PAGING INDICATOR)

25 12 bits (NO TRANSMISSION)

1 FRAME (10 ms)

[FIG.9]

NUMBER OF PAGING INDICATORS ( $N_p$ )

[FIG.10]

120 CHANNEL ENCODING SECTION

5 RG INFORMATION

121 SELECTION SECTION

122 REPETITION SECTION

123 MAPPING SECTION

TIMING INFORMATION

10 REPETITION COUNT

112 MODULATION SECTION

113 SPREADING SECTION

TO TRANSMISSION RADIO SECTION

115 TRANSMIT POWER SETTING SECTION

15

[FIG.11]

FROM RECEPTION RADIO SECTION

201 DESPREADING SECTION

202 DEMODULATION SECTION

20 210 CHANNEL DECODING SECTION

211 DE-REPETITION SECTION

212 POLARITY DECISION SECTION

RG INFORMATION

TIMING INFORMATION

25 REPETITION COUNT

[FIG.12]

131A SELECTION SECTION

## TIMING INFORMATION

## 132A REPETITION SECTION

## REPETITION COUNT

## 133A MAPPING SECTION

## 5 130 CHANNEL ENCODING SECTION

## RG INFORMATION

## 131B SELECTION SECTION

## 132B REPETITION SECTION

## 133B MAPPING SECTION

## 10 115A TRANSMIT POWER SETTING SECTION

## 112A MODULATION SECTION

## 113A SPREADING SECTION

## TO TRANSMISSION RADIO SECTION

## 112B MODULATION SECTION

## 15 113B SPREADING SECTION

## TO TRANSMISSION RADIO SECTION

## 115B TRANSMIT POWER SETTING SECTION

[FIG.13]

## 20 FROM RECEPTION RADIO SECTION

## 201A DESPREADING SECTION

## 202A DEMODULATION SECTION

## 220A CHANNEL DECODING SECTION

## 221A DE-REPETITION SECTION

## 25 222A POLARITY DECISION SECTION

## TIMING INFORMATION

## REPETITION COUNT

## 201B DESPREADING SECTION

202B DEMODULATION SECTION  
 220B CHANNEL DECODING SECDTION  
 221B DE-REPETITION SECTION  
 222B POLARITY DECISION SECTION

5 RG INFORMATION

[FIG.14]

141 SELECTION SECTION

142A REPETITION SECTION

10 143A MAPPING SECTION

140 CHANNEL ENCODING SECTION

REPETITION COUNT

RG INFORMATION

142B REPETITION SECTION

15 143B MAPPING SECTION

115A TRANSMIT POWER SETTING SECTION

TIMING INFORMATION

CODE ASSIGNMENT INFORMATION

112A MODULATION SECTION

20 113A SPREADING SECTION

TO TRANSMISSION RADIO SECTION

112B MODULATION SECTION

113B SPREADING SECTION

TO TRANSMISSION RADIO SECTION

25 TRANSMIT POWER SETTING SECTION

[FIG.15]

300 RADIO BASE STATION APPARATUS

## TRANSMISSION DATA

102 CHANNEL ENCODING SECTION

103 MODULATION SECTION

104 SPREADING SECTION

5 106 TRANSMIT POWER CONTROL SECTION

107 TRANSMISSION RADIO SECTION

## SIGNATURE INFORMATION

## TIMING INFORMATION

302 CHANNEL ENCODING SECTION

10 115 TRANSMIT POWER SETTING SECTION

113 SPREADING SECTION

112 MODULATION SECTION

## RG INFORMATION

## RR INFORMATION

15 32 SCHEDULING SECITON

## RECEPTION POWER MARGIN

31 RECEPTION POWER MEASURING SECTION

## MAXIMUM RECEPTION POWER

30 TPC GENERATION SECTION

20 29 SIR MEASURING SECTION

24 CHANNEL DECODING SECTION

## RECEIVED DATA

23 DEMODULATION SECTION

22 DESPREADING SECTION

25 20 RECEPTION RADIO SECTION

28 ERROR DETECTION SECTION

27 CHANNEL DECODING SECITON

26 DEMODULATION SECTION



## 25 DESPREADING SECTION

RECEIVED PACKET DATA

RR INFORMATION

5 [FIG.16]

302 CHANNEL ENCODING SECTION

TIMING INFORMATION

SIGNATURE INFORMATION

304 PATTERN TABLE

10 305-1 POLARITY INVERSION SECTION

305-2 POLARITY INVERSION SECTION

305-M POLARITY INVERSION SECTION

303 SELECTION SECTION

RG INFORMATION

15

[FIG.17]

65 TRANSMIT POWER MEASURING SECTION

TRANSMIT POWER MARGIN

MAXIMUM TRANSMIT POWER

20 57 TRANSMISSION RATE SELECTION SECTION

56 RATE REQUEST SELECTION SECTION

RG INFORMATION

63 TRANSMIT POWER CONTROL SECTION

OFFSET AMOUNT

25 58 TRANSMISSION PARAMETER SETTING SECTION

55 DATA AMOUNT MEASURING SECTION

61 SPREADING SECTION

60 MODULATION SECTION

59 CHANNEL ENCODING SECTION  
 RR INFORMATION  
 54 BUFFER  
 TRANSMISSION PACKET DATA  
 5 66 TRANSMISSION RADIO SECTION  
 52 SPREADING SECTION  
 51 MODULATION SECTION  
 50 CHANNEL ENCODING SECTION  
 TRANSMISSION DATA  
 10 64 TRANSMIT POWER CONTROL SECTION  
 42 RECEPTION RADIO SECTION  
 43 DESPREADING SECTION  
 46 SIR MEASURING SECTION  
 44 DEMODULATION SECTION  
 15 47 TPC GENERATION SECTION  
 45 CHANNEL DECODING SEC DTION  
 RECEIVED DATA  
 201 DESPREADING SECTION  
 202 DEMODULATION SECTION  
 20 401 CHANNEL DECODING SEC DTION  
 RG INFORMATION  
 TIMING INFORMATION  
 SIGNATURE INFORMATION  
 400 COMMUNICATION TERMINAL APPARATUS  
 25  
 [FIG.18]  
 401 CHANNEL DECODING SECTION  
 402 PATTERN IDENTIFICATION SECTION

## 403 POLARITY DECISION SECTION

RG INFORMATION

SIGNATURE INFORMATION

TIMING INFORMATION

5

[FIG.19]

COMMUNICATION TERMINAL N DOWNLINK CONTROL INFORMATION

(RG INFORMATION, ACK/NACK, etc.)

DOWNLINK CONTROL INFORMATION CHANNEL

10 COMMUNICATION TERMINAL 2 DOWNLINK CONTROL INFORMATION

(RG INFORMATION, ACK/NACK, etc.)

COMMUNICATION TERMINAL 1 DOWNLINK CONTROL INFORMATION

(RG INFORMATION, ACK/NACK, etc.)

COMMUNICATION TERMINAL N DEDICATED CHANNEL

15 COMMUNICATION TERMINAL N DEDICATED CHANNEL DATA

COMMUNICATION TERMINAL N DEDICATED CHANNEL

COMMUNICATION TERMINAL 2 DEDICATED CHANNEL

COMMUNICATION TERMINAL 1 DEDICATED CHANNEL

TIME

20 1 FRAME

[FIG.20]

(a) ACCESS SLOT

TRANSMISSION CHECK (AI)

25 (b) PREAMBLE

PREAMBLE

MESSAGE SECTION

[FIG.21]

ACQUISITION INDICATOR SECTION

4098 CHIPS, 32 SYMBOLS      1024 CHIPS

NO TRANSMISSION

5

[FIG.23]

500 RADIO BASE STATION APPARATUS

TRANSMISSION DATA

102 CHANNEL ENCODING SECTION

10 103 MODULATION SECTION

104 SPREADING SECTION

106 TRANSMIT POWER CONTROL SECTION

107 TRANSMISSION RADIO SECTION

TRANSMIT POWER OFFSET

15 502 AVERAGE POWER CALCULATION SECTION

TIMING INFORMATION

503 TRANSMIT POWER SETTING SECTION

113 SPREADING SECTION

111 CHANNEL ENCODING SECTION

20 112 MODULATION SECTION

RG INFORMATION

RR INFORMATION

32 SCHEDULING SECTION

RECEPTION POWER MARGIN

25 31 RECEPTION POWER MEASURING SECTION

MAXIMUM RECEPTION POWER

30 TPC GENERATION SECTION

29 SIR MEASURING SECTION

24 CHANNEL DECODING SECTION  
 RECEIVED DATA  
 23 DEMODULATION SECTION  
 22 DESPREADING SECTION  
 5 20 RECEPTION RADIO SECTION  
 28 ERROR DETECTION SECTION  
 27 CHANNEL DECODING SECTION  
 26 DEMODULATION SECTION  
 25 DESPREADING SECTION  
 10 RECEIVED PACKET DATA  
 RR INFORMATION

[FIG.24]

COMMUNICATION TERMINAL 1 DOWNLINK CONTROL INFORMATION  
 15 (RG INFORMATION, ACK/NACK, etc.)  
 COMMUNICATION TERMINAL 2 DOWNLINK CONTROL INFORMATION  
 (RG INFORMATION, ACK/NACK, etc.)  
 COMMUNICATION TERMINAL N DOWNLINK CONTROL INFORMATION  
 (RG INFORMATION, ACK/NACK, etc.)  
 20 TRANSMIT POWER  
 DOWNLINK CONTROL INFORMATION CHANNEL  
 TIME  
 1 FRAME

25 [FIG.25]

COMMUNICATION TERMINAL 1 DOWNLINK CONTROL INFORMATION  
 (RG INFORMATION, ACK/NACK, etc.)  
 COMMUNICATION TERMINAL 2 DOWNLINK CONTROL INFORMATION

(RG INFORMATION, ACK/NACK, etc.)

COMMUNICATION TERMINAL N DOWNLINK CONTROL INFORMATION

(RG INFORMATION, ACK/NACK, etc.)

TRANSMIT POWER

- 5 DOWNLINK CONTROL INFORMATION CHANNEL  
TIME  
1 FRAME

[FIG.26]

- 10 COMMUNICATION TERMINAL  
BASE STATION  
RADIO NETWORK CONTROL STATION  
TIMING INFORMATION  
SIGNATURE INFORMATION
- 15 SPREADING CODE INFORMATION  
SCRAMBLING CODE INFORMATION  
TIMING INFORMATION  
SIGNATURE INFORMATION  
SPREADING CODE INFORMATION

20

[FIG.27]

- 800 COMMUNICATION TERMINAL  
USER DTA  
CONTROL
- 25 600 RADIO NETWORK CONTROL STATION  
USER DATA  
PHYSICAL CHANNEL PARAMETER  
CONTROL

700 BASE STATION  
RADIO INTERFACE